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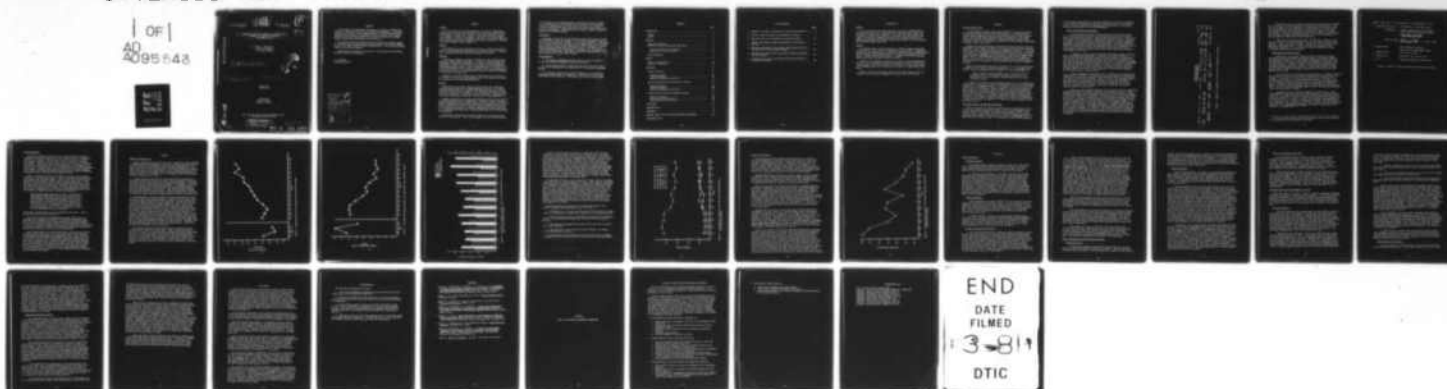
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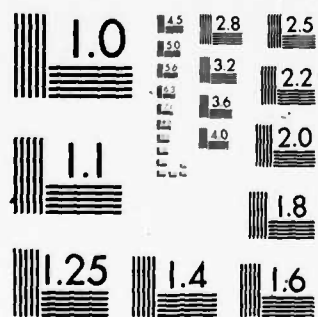
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6 PERFORMANCE CONTINGENT REWARDS AND PRODUCTIVITY:
A SUMMARY OF A PROTOTYPE INCENTIVE
MANAGEMENT SYSTEM.

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FOREWORD

This research and development was conducted in support of Exploratory Development Task Area ZF55.521.018, Organizational Management. The primary purpose was to provide a better understanding of the relationship between employee motivation and work performance, which is needed to provide Navy management with information required to evaluate proposed policy changes aimed at making Navy organizations more productive.

The results of the work reported here are primarily intended for use by the Long Beach Naval Shipyard (Code 110), Naval Sea Systems Command (NAVSEA 072 and 073), Chief of Naval Material (NAVMAT 09M41), and the data processing centers at the Naval Shipyards.

Appreciation is expressed to the staff of the Long Beach Naval Shipyard for their support and cooperation.

J. J. CLARKIN
Commanding Officer

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SUMMARY

Problem

Due to the high cost of human resources, the need to substantially reduce personnel costs without undermining the long-range quality and effectiveness of the work force continues to be a major Navy-wide concern. In an attempt to address this problem, a Performance Contingent Reward System (PCRS), an incentive management system that uses economic incentives to increase productivity, was tested on data entry processors at the Long Beach Naval Shipyard (LBNS) during 1977.

Purpose

The objectives of this effort were to provide a summary evaluation of PCRS as to its effects on productivity and to address a number of management and personnel related concerns surrounding the program.

Approach

The PCRS was designed according to theoretical axioms derived from an expectancy theory of work motivation. A system of work measurement and performance standards was developed, and a computer software package was redesigned to provide the data base for evaluating work performance and determining monetary rewards. Minor changes were made in the physical layout and work methods of the data entry operators and in some supervisory practices, and the task of coordinating the incentive program was assigned to the second level supervisor.

Measures of individual productivity and efficiency were monitored for the period of the report (January-December 1977), and compared with those for a period prior to program implementation.

Results

Keystroke rate, the basic measure of productivity, has increased by 25 percent when compared with a preimplementation baseline. The chronic overtime condition has been eliminated and individual productive time has increased to 110 percent of expected. This combination of speed and efficiency has allowed for a 22 percent reduction in personnel (through normal attrition), resulting in significant cost savings to the organization.

Monetary incentives for increased productivity have had little effect on job satisfaction and rates of absenteeism. Although a number of specific complaints regarding work have been ameliorated by the program, the dominant factor influencing job satisfaction appears to be promotion--which is not possible in the task involved. Rates of absenteeism have been unaffected to any significant degree by the program, although the problems associated with absenteeism have lessened to a considerable degree due to the increases in productivity.

High levels of productivity have also resulted in slack periods when there is not enough work. This is particularly true for the day shift and

to some extent for the graveyard shift, indicating the need for changes in the configuration of the working force or the work to be processed. This need is underscored by the fact that there have been incidents of competitiveness for work under the monetary incentive program during slack periods, and suggests a redistribution of the work to ensure an equal opportunity for incentive bonuses.

Conclusions

Management of the flow of work through the data entry section has been greatly enhanced since the inception of the incentive management program. The increase in efficiency afforded by a 25 percent increase in performance rate has also resulted in a scarcity of work, highlighting the role of the shift supervisor in the proper distribution of work. Presently a problem exists with the division of work on the day shift. This situation is further aggravated by the large amount of card punch (vs. key entry) work that exists on that shift. This work is essentially unmeasured and is not being distributed in an equitable fashion.

Recommendations

1. The incentive management program should be continued because of the obvious benefits associated with high productivity.
2. Steps should be taken to bring the card punch work under control so that it can meaningfully be incorporated into the incentive management program.
3. Supervisors should be more fully integrated into the incentive management program during the coming year. Problems that exist at this level might be alleviated with a PCRS based upon their job requirements.

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INTRODUCTION

Problem

Due to the high cost of human resources, the need to substantially reduce personnel costs without undermining the long-range quality and effectiveness of the work force continues to be a major Navy-wide concern. In an attempt to address this problem, a Performance Contingent Reward System (PCRS), an incentive management system that uses economic incentives to increase productivity, was tested on data entry processors at the Long Beach Naval Shipyard (LBNS) during 1977.

Purpose

The primary purpose of this effort was to provide a summary evaluation of the PCRS, as to its effects on productivity and efficiency. The general impetus for this summary arose as a result of discussions between LBNS managers and the authors concerning the potential for general implementation of this system to other data processing centers. A number of the issues addressed herein have direct relevance to those discussions.

A related, but secondary, purpose was to provide a short description of the PCRS. It is anticipated that this description, along with other referenced documents, will form the basis for the design of a more general incentive management system for the key entry sections of all eight naval shipyards.

Finally, some of the important aspects of the LBNS program in the less tangible areas of personnel management and supervision are discussed.

APPROACH

Theoretical Relevance

The Performance Contingent Reward System (PCRS) is an incentive management program having two distinctive characteristics: (1) specified performance requirements based upon work measurement and performance standards and (2) clearly specified performance-reward contingencies. These basic features are explicit applications of theoretical axioms derived from an expectancy theory of work motivation (Nebeker & Moy, 1976; Nebeker, Dockstader, & Shumate, 1978; Vroom, 1964).

Managers who have effectively used incentive programs may argue that the principles used to design the PCRS are not unique to any particular scientific theory but, rather, simply constitute "good management practice." It is true that theory can prescribe good management practice, but the lack of a theoretical orientation to management has resulted in the failure of many incentive systems and other management practices (Hackman, 1975; Hammer & Hammer, 1976; Sherry, 1974). A well developed theoretical orientation or framework provides a perspective that is (1) logically consistent with sound behavioral principles and (2) more global in its application than a specific management practice.

Since the general expectancy theory of work motivation has been described in Nebeker et al. (1978), a detailed treatment of it is not necessary here. However, the basic assumption, as it relates to incentive management, is:

When a reward is made contingent upon a particular level of performance (and it is possible to perform at that level), an individual will strive to achieve the performance level in order to gain the reward.

As simple and intuitive as this statement appears to be, it includes some rather subtle nuances that require some explanation if it is to be effectively implemented as a management practice. For instance, what is meant by "a particular level of performance," "made contingent," and "strive to achieve?" What is meant by a "a reward" and why is there no mention of punishment for not achieving the performance level? All of these questions demand rather specific answers when one is designing a management program around the use of incentives. The manner in which this program was designed and implemented at LBNS, which was based on scientific theory in the area of work motivation, is described in detail in Shumate et al. (1978) and outlined briefly in the following section.

Production Control Through Work Measurement

Before any program for improving productivity can be designed, the production system must be analyzed in detail to allow an understanding of the primary factors that influence the individual's productive output. Such factors include: input volume, work flow, system technology, supervision, performance capabilities of the work force, the role of management, etc. To assess the role of these factors, it is necessary to have reliable measures

of work output and efficiency. Once these measures are available, the factors can be varied to determine their effects on productive output. Total productivity can then be assessed by using appropriate measures of output volume, efficiency, and quality control (if appropriate).

Output and Efficiency Measurement

It was comparatively easy to obtain measures of work volume and rate for the key entry task because the key entry stations automatically record most of the information required. This information passes directly from station to temporary disc storage and is subsequently transferred to tape. A production report of this information is then obtained using a software package made available by the Computer Machinery Corporation (CMC). This basic software program was modified to provide relevant production and time management information, as well as several indices of efficiency, which form the basis for determining the amount of incentive pay earned through individual performance (see Shumate et al., 1978).

An example of the printout of the modified software package, called the Operator Analysis Reporting System II (OARS II), is provided in Figure 1. As shown, the production information that is directly available from the printout includes (1) total keystrokes produced--writing (W) and verifying (V), (2) the time required for production in actual hours, and (3) keystroke rate (KS/HR). This and the information described below is entered into the OARS II program for the period of the report (daily, weekly, etc.) and the cumulative totals are entered separately on a year-to-date basis. Although the report uses the individual operator as the basic unit of analysis, it also provides summaries for each shift and for the shop totals.

The time management information, which is located on the printout under "PERCENT TIME," indicates the proportion of the workday spent (1) writing and verifying at the key entry stations, (2) working on the IBM card punch machines, and (3) on work other than production (OTH). The basic time management data are maintained by the supervisor for each data entry operator and input separately into the OARS II program. These data, aside from their obvious value as a record of work activities, are used in connection with the efficiency measures described below.

There are three efficiency measures, which form the basis for determining appropriate amounts of incentive awards for the individual operators. These measures are labeled "% EFF" (Percent Efficiency), "PRO TIM" (Productive Time), and "PROD EFF" (Productive Efficiency). Each relates the operator's performance on the various data entry procedures to the work standards developed for those procedures. For example, "% EFF" represents an operator's performance rate, in terms of keystrokes per hour (KS/HR) relative to a performance standard. It is given separately for writing and verifying, and a weighted average is provided for the two tasks. For example, in Figure 1, operator #38 was performing at 94 and 107 percent of standard writing and verifying respectively, and had a (weighted) average of 102 percent. This measure is readily interpreted in terms of the relationship between an operator's performance rate and what the expected rate is for the particular mix of work performed for that reporting period.

"PRO TIM" is the ratio of CMC¹ writing and verifying time (as recorded) by the machine) to the time assigned to the machine by the supervisor. That is, it is a measure of the proportion of assigned time the operator actually spent performing data entry operations. A correction factor is built into this measure to compensate for time lost during setup, breaks, and change-over periods. Since it is possible for this ratio to exceed 1.0 when a person skips a break, proceeds quickly through setup, etc, it is an indication of how efficiently the operator uses his working time.

"PROD EFF" is the product of "% EFF" and "PRO TIM." Therefore, this measure is sensitive to both performance rate and the efficient use of working time. Again, referring to Figure 1, operator #38 was only slightly above standard in performance rate (A = 102), but used his working time very efficiently (PRO TIM = 125). The product of these two measures indicates a productive efficiency of 128 percent.

Calculation of Incentive Award

Chapter 451 of the Federal Personnel Manual outlines the Federal government's policy with regard to incentive awards. The Superior Achievement award was selected for the LBNS incentive management program because of its flexibility. The amount of the award is determined as a fraction of the "tangible benefits," in terms of dollars saved the Federal government, that are derived from an individual's efforts. In this case, tangible benefits resulted from performance that exceeded "an expected amount of work," which was determined by the work standards produced for the data entry task (see Shumate et al., 1978).

The actual size of the incentive award (referred to as BONUS in Figure 1) was 11 percent of the amount saved the government due to high individual performance. For example, if an individual is performing at 150 percent of standard, the government is actually saving 50 percent of his salary, since he is essentially doing his own work plus half of the work of a hypothetical person. Using such logic provides an easily interpretable and defensible manner to determine "tangible savings" and, thus, the amount of the incentive award. For the incentive management program at LBNS, the award was determined using the formula shown in Figure 2.

Two aspects of this formula are important to mention here. First, "MACHINE HOURS" constitutes the time actually assigned to the machine by the supervisor. As mentioned earlier, this information is obtained from a record kept by the supervisor. Since it is used as a multiplier in this equation, it is essential that it be accurate. Second, the 11 percent sharing percentage is an arbitrary value. Chapter 451 recommends 10 percent, but this figure is only a guideline. The important factor to bear in mind is that the figure used represents only a fraction of the savings, which gives real meaning to the concept of a "sharing rate."

¹Use of the terms "CMC" and "IBM" in this report is not to be interpreted as an endorsement by the Department of the Navy.

$$\text{BONUS} = (\text{PROD. EFF.} - 1) \times (\text{Machine Hours}) \times (\text{Recharge Rate}) \times (.11)$$

$$1. \text{ Production Efficiency} = (\% \text{ efficiency}) \times (\text{productive time})$$

$$\% \text{ Efficiency} = \text{weighted average of write and verify rates as they relate to the standards}$$

$$= \frac{(W\% \times \text{WHRS}) + (V\% \times \text{VHRS})}{\text{SUM OF WHRS and VHRS}}$$

$$\text{Productive Time} = \frac{(\text{WHRS} + \text{VHRS})}{\text{Hrs assigned to CMC}} / .75 \text{ (Max} = 1.25)$$

$$2. \text{ Machine Hours} = \text{hours assigned to machine}$$

$$= (\% W + \% V + \% \text{ IBM}) \text{ expected hours}$$

$$\text{Expected Hours} = \text{Total hours at work}$$

$$3. \text{ Recharge Rate} = \text{hourly cost of key entry work}$$

$$4. \text{ 11\%} = \text{sharing percentage of cost savings}$$

Figure 2. OARS II: Bonus calculation and derivation of indices.

System Management

The OARS II program provides not only a highly efficient automated management information system but also a data-based record of performance that allows a precise determination of the size or amount of the award. The program is, however, only one aspect of the total incentive management system. Production control, as was pointed out earlier, also involves such factors as work flow, work volume, supervision, and management, each of which must be assessed prior to the implementation of an incentive management program. Although these features are discussed at length in Shumate et al. (1978), the roles played by supervisors and the Incentive Management Coordinator (IMC) at LBNS are briefly summarized below.

Ideally in production jobs of this nature, the first line supervisor fulfills at least three basic roles: those of technical expert, production flow manager, and personnel manager. None of these roles includes direct production by the supervisor--only through his/her subordinates. In the key entry section at LBNS, this is easily accomplished because each first line supervisor (GS-5) is assisted by a lead data transcriber (GS-4), who can fill in when work volume is high. The basic requirements for production control by supervisors are outlined in the following paragraph, which was provided to supervisors prior to system implementation:

The supervisor will not punch or verify. The supervisor will schedule equal time on CMC for all operators, pull the procedures, distribute the procedures and the work to each operator at their respective machine, pick up completed work at the machine, research bad documents, do a system save at lunch time only, and your normal transfer at the end of job. In order for the operators to build up their savings account, it will be necessary for them to be at their machines at much as possible.

The incentive program imposes only one additional requirement: that of maintaining each operator's time record.

The role of the Incentive Management Coordinator (IMC), which is described in the appendix, is unique to the incentive management system. Since the IMC is responsible for the maintenance and continued development of the system, the incumbent must be carefully selected and trained for the job. In larger production facilities, the task would be accomplished by a group of people who comprise the productivity enhancement section and usually report directly to the head of the organization.

For the LBNS program, it was determined that the IMC would be required to spend as much as 50 percent of her time during the first 6 months on the development and debugging of the management system. After that time, the program entered the "system maintenance" phase and required only 20 to 30 percent of the IMC's time. It should be emphasized that the IMC must be an "active manager" with a working knowledge of the management information system (MIS) and the behavioral principles involved. The IMC should also have the capacity and vested authority to make personnel decisions that are necessary for the vitality of the incentive management program. If the situation allows, the IMC is in direct communication with the department head (Code 110 at LBNS).

RESULTS

Effects on Productivity

Figure 3 compares the keystroke rate (i.e., keystrokes per hour (KS/HR)), the basic measure of productivity, for the 1977 calendar year with that for the 3-month period that immediately preceded system implementation. As shown, by the end of 1977, the keystroke rate was approximately 25 percent higher than that for the baseline period. This highly significant increase can be attributed to the effects of the incentive program rather than to changes in work flow or methods, since such changes preceded program implementation (Shumate et al., 1978).

It should be noted that the hour, which was used as the time unit to determine keystroke rate, does not provide a clear indication of total productivity; that is, the volume of the work being accomplished. Variation in such volume can effect production management. For example, at the LENS data entry section, the total keystroke volume on the CMC machines was about 875,000 strokes per day during 1976, and about 800,000 keystrokes per day during the latter part of 1977. Thus, there has been a decrease in keystroke volume of roughly 9 percent, which is largely due to the fact that some data entry jobs are now being processed locally at the work sites.

The combination of these two factors--increase in keystroke rate and decrease in work volume--have resulted in a reduction of the time required on the CMC machines to process the daily workload. This is clearly seen in Figure 4, which compares the daily average use of the CMC key stations during 1977 with that of the 3-month preincentive period. The latter period is not totally representative of 1976, since the overall average for 1976 was approximately 10 hours per day. Currently, CMC usage is approximately 9 to 10 hours per day and appears to have leveled off at this rate. The elevated usage during the preincentive period reflects the changes in supervisory practice and work methods during that time; and the elevated usage during the first few months of 1977 reflects the fact that the operators had more work, in terms of backlog, than they have had since then. Once the CMC backlog was reduced to zero, the amount of machine time fell off rapidly and leveled out during the summer months. In August, CMC time again decreased due to the loss of the JML procedures. Since then, the CMC workload appears to have stabilized.

The 9 percent decrease in CMC workload over the course of the year has had the most effect on the day shift. Figure 5 indicates the proportions of the total CMC key entry activity performed by each shift during the year. As shown, the highest proportion of CMC workload has always been borne by the swing shift, and that proportion has increased over the year to over 50 percent. Correspondingly, the day shift's share of the workload has dropped from over 25 percent to about 15 percent; and the graveyard shift has suffered an overall decrease, although not to the same extent.

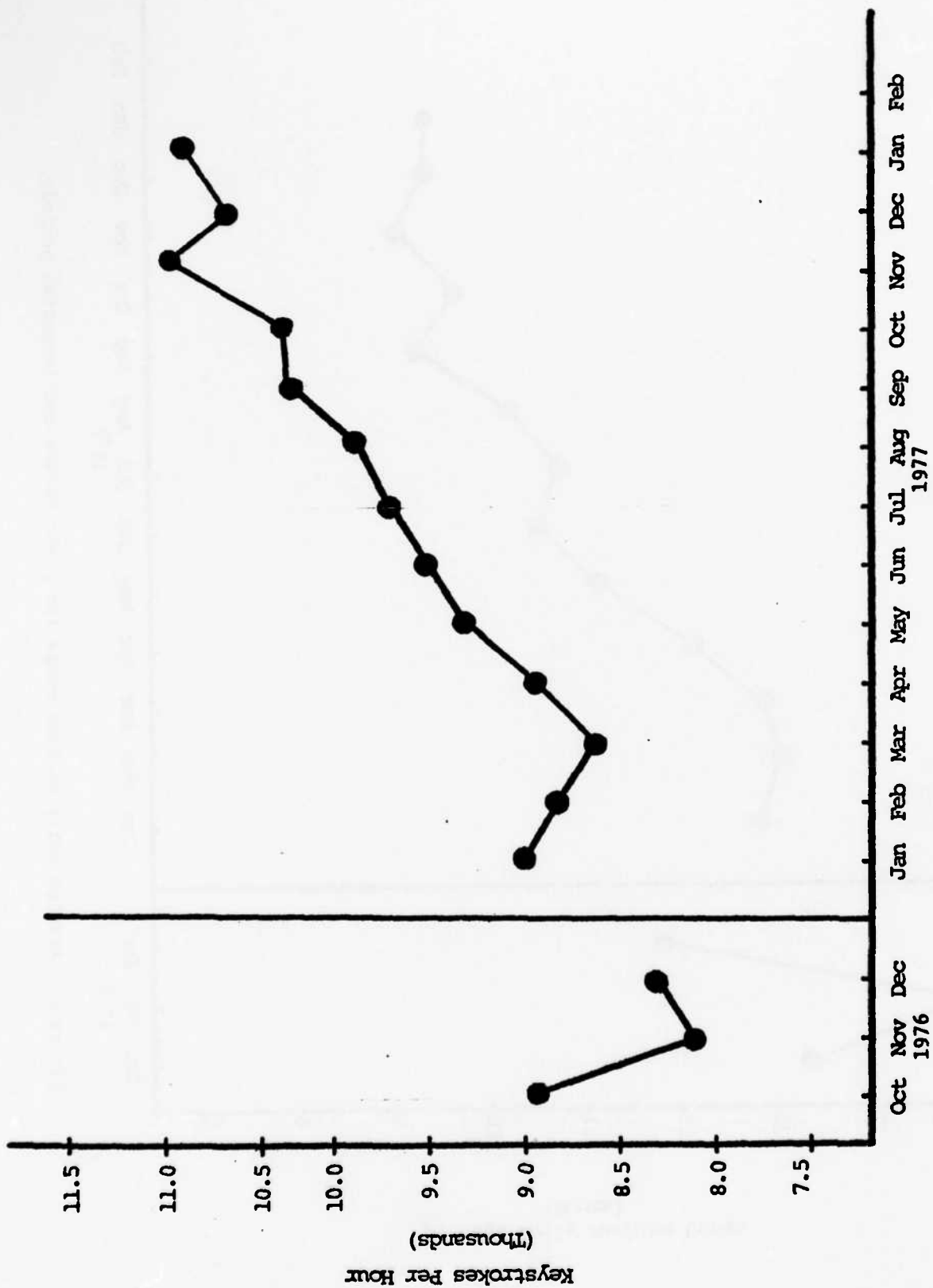


Figure 3. Keystroke rates for preincentive and incentive periods.

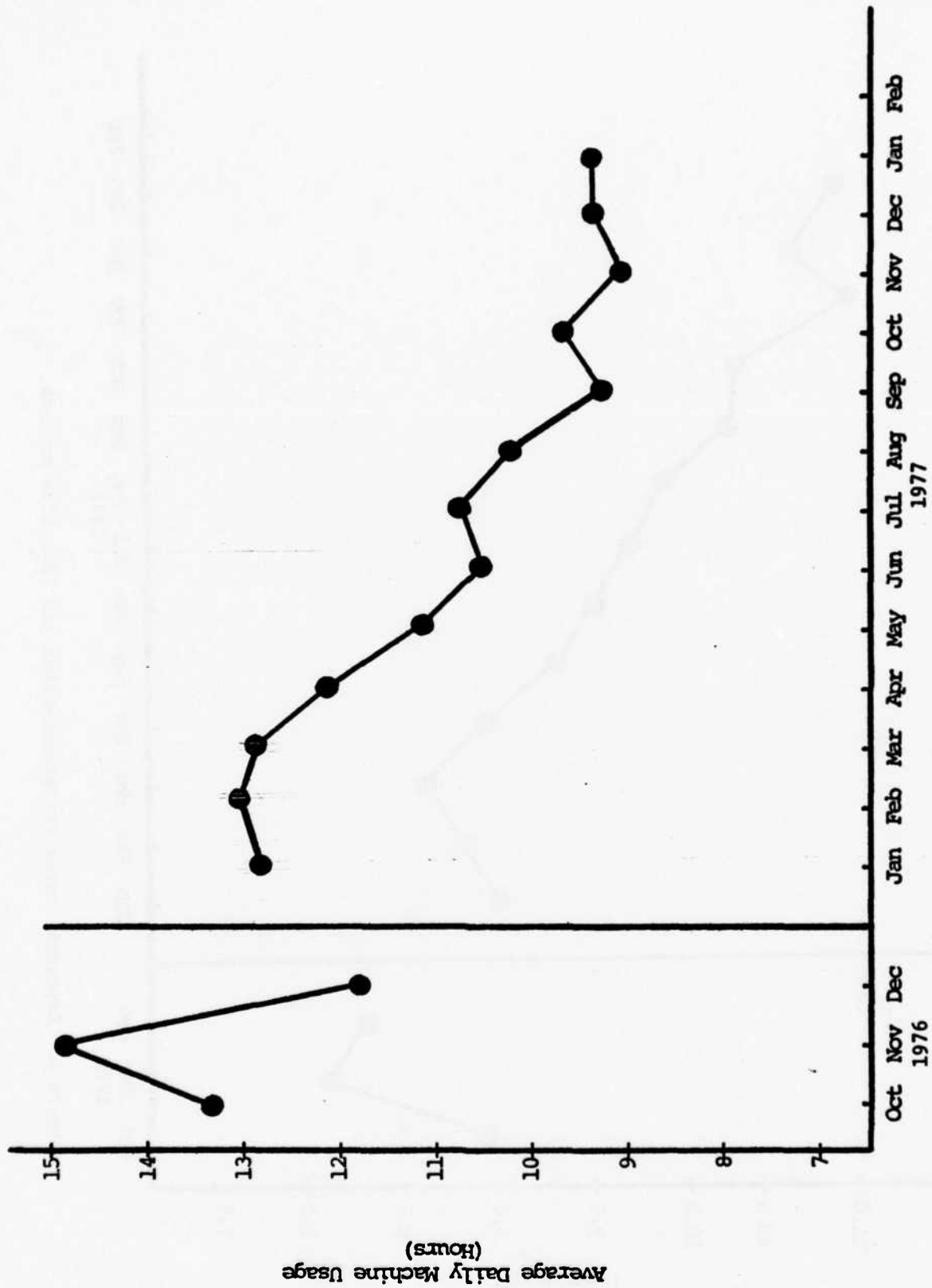


Figure 4. Average daily machine usage for preincentive and incentive periods.

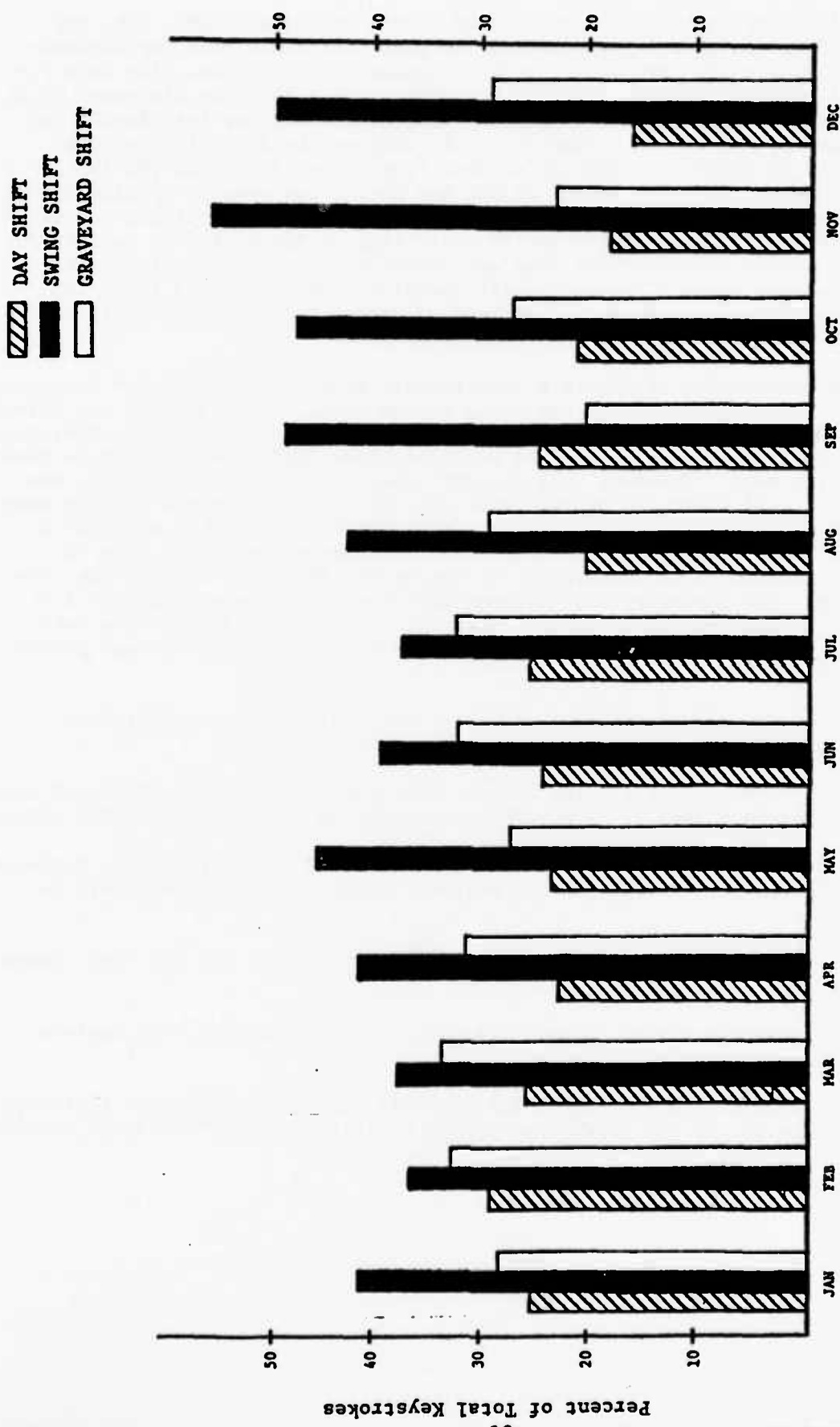


Figure 5. Keystroke percentage for Day, Swing, and Graveyard shifts for the first year of the incentive program.

Figure 6, which depicts the trend in the work mix of CMC, IBM, and nonproduction (other) tasks during the year, indicates that the decrease in CMC volume has been offset by an increase in IBM volume. The data for this figure was derived from the "PERCENT TIME" statistics discussed earlier and show the time operators spent working at the various functions. The decrease in CMC time corresponds to the decrease in day shift workload depicted in Figure 5. What is evident from Figure 6 is that IBM time, which has the greatest impact on the day shift, has roughly doubled during the course of the year. During the early months of the program, day shift operators spent only 25 percent of their time on IBM work, but records for recent months indicate that they are spending 40 to 50 percent of their time on such work. Graveyard shift operators have increased their IBM workload somewhat, and there has been no change for the swing shift—which historically has had almost no card punch work.

An examination of Figure 6 also reveals that "Other" time has increased almost four fold since the beginning of the year. This category was intended to be something of a catchall, which was to indicate how much the operators were involved with collateral or administrative duties in addition to their key entry work. However, this category also accounts for idle time, and there is good reason to believe that the 400 percent increase in this category is a strong reflection of such "activity." Although it would be a simple matter to verify this assumption by observation, or to have the operators confirm it themselves, it can be verified by examining the other figures. For instance, the increase in "Other" time coincides with a decrease in CMC activity (Figures 5 and 6), an increase in keystroke rate (Figure 3), and a decrease in overtime and backlog during the same period (see Shumate et al., 1978).

Before proceeding to an analysis of the efficiency measures, four summary statements concerning productivity are in order.

1. Performance rate, the most sensitive measure of the effects of incentives, has increased by 25 percent when compared to the preincentive period.
2. There has been a decrease in CMC workload volume since the beginning of 1977, but this decrease has apparently been offset by an increase in IBM work.
3. The changes in performance and the mix of work has not been consistent across all shifts.
4. Nonproductivity (other) time has greatly increased, but appears to have stabilized at 20 percent.

The ramifications of these findings will be discussed later, following an examination of the effectiveness and efficiency of the key entry section.

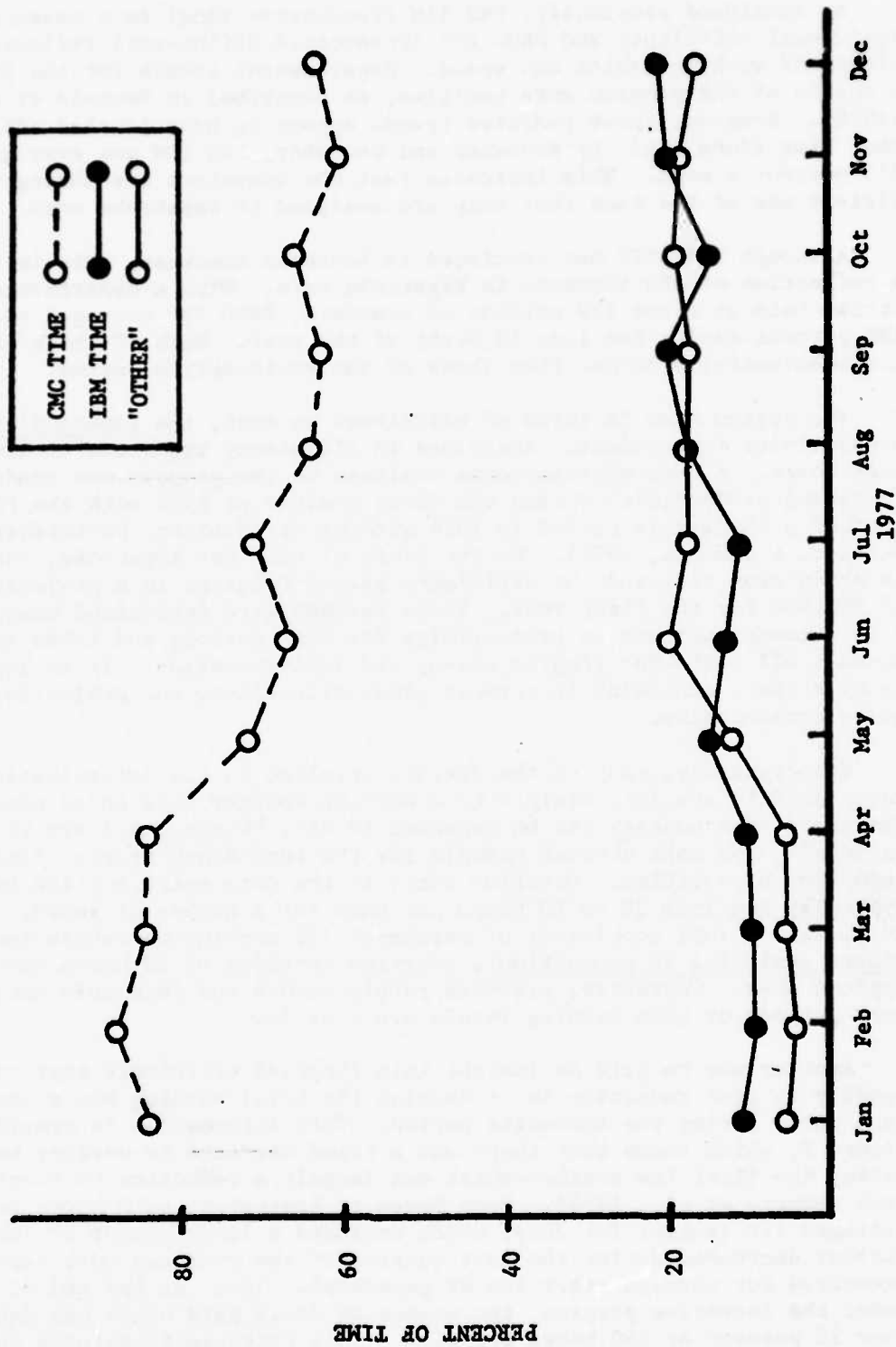


Figure 6. Distribution of work time for data entry operators during the incentive program.

Effects on Efficiency

As mentioned previously, PRO TIM (Productive Time) is a measure of individual efficiency and PROD EFF (Productive Efficiency) reflects both efficient working habits and speed. Departmental trends for the first 6 months of the program were positive, as described in Shumate et al. (1978). However, these positive trends appear to have leveled off after that time (June) and, by November and December, PRO TIM was averaging about 110 percent a week. This indicates that the operators are making very efficient use of the time that they are assigned to keystroke work.

Although PROD EFF has continued to increase somewhat, this is largely a reflection of the increase in keystroke rate. With a departmental keystroke rate at about 120 percent of standard, PROD EFF averaged nearly 130 percent during the last 10 weeks of the year. Both of these statistics are substantially larger than those of the preincentive period.

The bottom line in terms of efficiency is cost, the raison d'être for productivity improvement: Increases in efficiency translate to lower per unit costs. A cost effectiveness analysis of the program was conducted comparing productivity during the first quarter of 1976 with the PCRS to that of a comparable period in 1976 without it (Bretton, Dockstader, Nebeker, & Shumate, 1978). On the basis of cost per keystroke, the increases in production rate and the efficiency gained resulted in a projected savings of \$66,000 for the first year. Those savings were determined based on a 13 percent increase in productivity for that period, and takes into account all costs for program set-up and implementation. It is important to note that, according to current production rates, the projection was quite conservative.

Unfortunately, many of the factors involved in the determination of cost/benefits are less visible to a working manager than to an economist. Therefore, the manager can be expected to ask, "Where can I see these savings?" The most obvious example for the Long Beach program lies in the reduction of overtime. Overtime rates in the data entry section had typically run from 30 to 60 hours per week for a number of years. During 1976, with a full complement of personnel (27 working operators and 3 supervisors assisting in production), overtime exceeded 40 hours during a typical week. Currently, overtime rarely occurs and then only during peak work periods or when manning levels are very low.

Another way to gain an insight into improved efficiency that translates readily to cost reduction is to examine the total working hours logged by data entry during the incentive period. This information is provided in Figure 7, which shows that there was a rapid decrease in working hours during the first few months—which was largely a reduction in overtime (see Shumate et al., 1978). From March to September, paid hours per day averaged 170 (except for July, which included a large amount of leave time). Further decreases during the last quarter of the year can most easily be accounted for through attrition of personnel. Thus, at the end of 1 year under the incentive program, the number of daily paid hours has decreased by over 25 percent or 250 hours per week. This decrease translates to the salary of more than six persons—a figure that is easy to use in the determination of savings, and one that can easily be verified from payroll records.

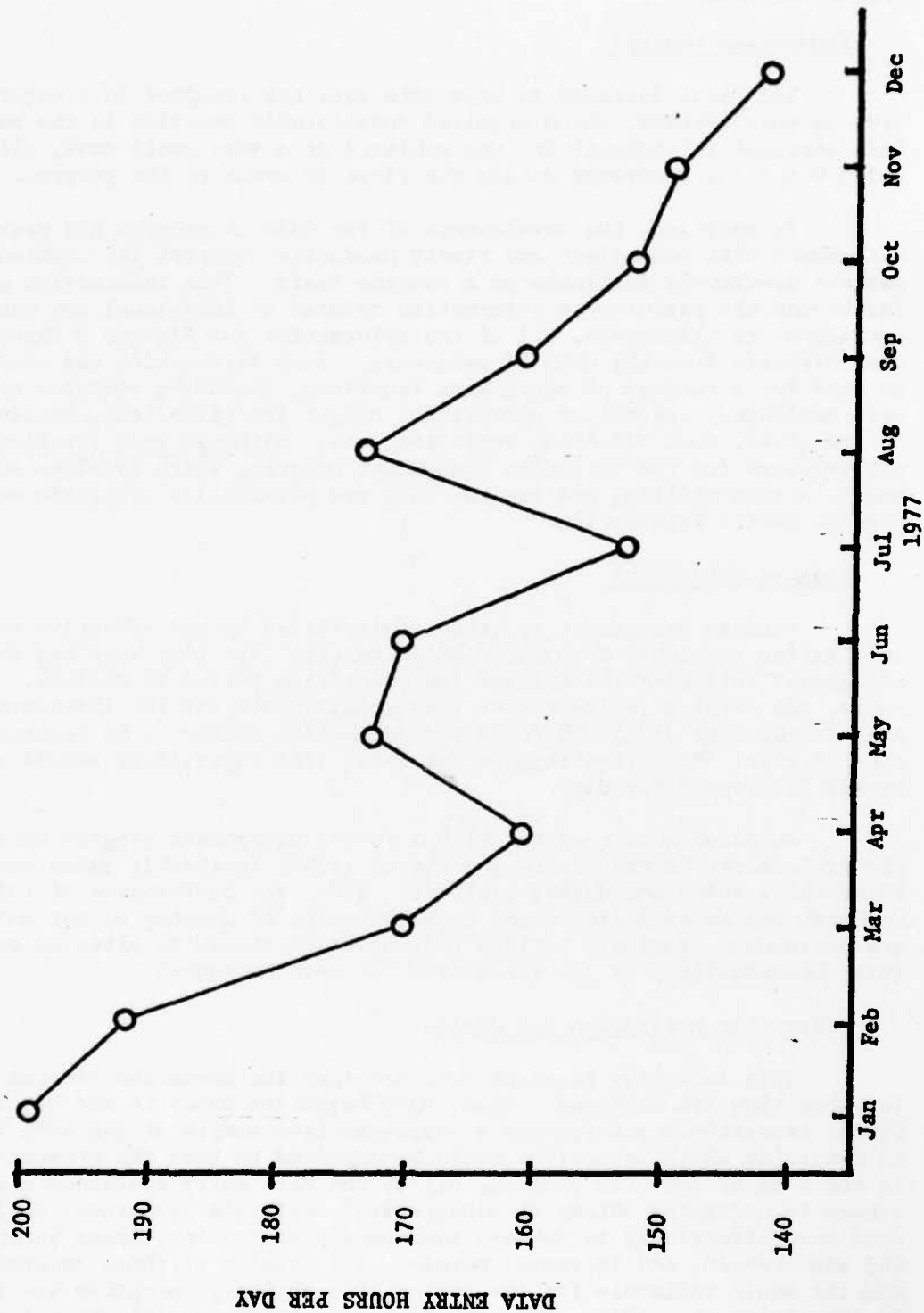


Figure 7. Average hours per day for data entry operations during 1977 (supervisors excluded).

DISCUSSION

System Advantages

Production Control

The large increase in keystroke rate has resulted in a major reduction in work backlog, which required considerable overtime in the past. This increase in productivity was achieved at a very small cost, all of which was fully recovered during the first 12 weeks of the program.

In addition, the development of the OARS II program has provided management with convenient and timely production control information that was not previously available on a routine basis. This information goes far beyond the performance information related to individual key entry operators—to illustrate, all of the information for Figures 3 through 7 came directly from the OARS II printouts. Such information can readily be used for a variety of management functions, including resource management estimates, control of operations, budget justifications, reallocation of resources, cost reduction estimates, etc. Although such functions are not required for the incentive management program, which involves setting goals, accountability, and reward, they are potentially available and can provide useful information.

Program Management

Program management is greatly simplified by the effective use of the information available from the OARS II report. The time required for such management following the initial implementation period is minimal. For example, the original estimates of time requirements for the Incentive Management Coordinator (IMC)—20 to 30 percent—still appear to be reasonable after 1 year. Time requirements for first line supervisors should not exceed 30 minutes per day.

An added advantage to using a formal management program such as the Performance Contingent Reward System (PCRS) is that it makes managerial/supervisory roles and duties explicit. Thus, the performance of role incumbents can be evaluated based on observation of whether or not duties are performed. Further, serious consideration should be given to using this accountability as job incentives for such personnel.

Effects on Motivation and Morale

True incentive programs must consider the needs and desires of those for whom they are designed. Thus, Navy Personnel Research and Development Center researchers interviewed a representative sample of the work force to determine which incentives could be expected to have the greatest effects. In the case of the LBNS program, all of the data entry operators were interviewed to determine which, of managements' available resources, could be used most effectively to achieve increased productivity, lower turnover and absenteeism, and increased morale. The results of those interviews and the basic rationale for the choice of a monetary incentive are reported in Shumate et al., 1978. However, in light of the results after 1 year, some of this reasoning is worthy of reexamination.

First, from the standpoint of the value of the incentive, money by itself was not the most highly desired reward sought by the employee. At the time interviews were conducted, the most highly valued reward was (and is to this day) promotion. However, if the aim of the program is productivity, promotion may not be the best reward because the performance contingency is not continuous; that is, the requirement (high productivity) to receive the reward exists only until the time when the reward is presented. After that, promotion loses its motivating properties since it cannot be offered again for high performance; the "career ladder" for data processors, such as it is, does not extend beyond the level of lead data transcriber (GS-4). This is typical with many so-called incentives or rewards: They either totally lack a specified performance requirement or they can only be administered so infrequently that they lack true incentive properties, or both. The monetary program described here provides a clearly defined and continuously operating incentive: As performance increases above standard, so does the value of the incentive—with exact correlation. If performance drops below standard, there is no reward; thus, unlike other "motivational" programs, there is no real Hawthorne effect and no recidivism. While it might be suggested that promotion would have a more positive effect on morale than the incentive system, it is quite likely that its effects on productivity would be transient.

The incentive program has provided social recognition for the data entry operators—a factor which they indicated in their interviews was of considerable importance. All but one of the operators who were at LBNS for 2 years prior to program implementation indicated that they are more satisfied on their job and that conditions are better because of the incentive system.

The representative of the American Federation of Government Employees reports that the incentive program has received increased acceptance among the union associated operators. Further, she has recommended that the program be extended to other operators throughout the shipyard. The only recent complaints that can be associated with the program were linked with the manner in which work was being distributed by the supervisor. The complaint was not that work was not being fairly distributed but, rather, that there was not enough work.

The problem of turnover is difficult to evaluate this early in the life of the program. There has been much less turnover this year than in prior years but, unless the reasons for turnover can be identified, it will be difficult to isolate the controlling factors. The turnover rate in and of itself can only become meaningful when examined at a future time. The problem of absenteeism is discussed in the next section.

System Implementation and Maintenance Problems

Production Control

To this date, management has made very little effective use of the production control information available from OARS II. The only functions that have been served thus far are determining bonus amounts for the incentive

program, and providing feedback to the operators concerning their performance. Although these were NAVPERSRANDCEN's primary reasons for developing OARS II, its potential uses go far beyond these, as suggested in the previous section. It is somewhat ironic that there is so little usage of a management information system (MIS) in a department whose business is management information. Perhaps this situation would change if the workload were such that it demanded more efficiency from the work flow system.

Program Management

As indicated previously, the design of the incentive management program included a requirement for an Incentive Management Coordinator (IMC), whose responsibilities are outlined in the appendix, and which require about .3 man-year. Unfortunately, these responsibilities have been added to those of an existing billet and many of them have been neglected as a result. The underutilization of the OARS MIS, indicated above, is partly due to this situation.

Incentive programs aimed at increasing productive rate must be designed such that work flow is facilitated; that is, productive rate should not be hampered by obstructions in the "pipeline." Since work flow facilitation is the primary responsibility of the supervisors, they were given formal notice of the particular work flow activities required by the incentive program before its implementation. In addition, certain equipment was provided and human engineering considerations produced changes in the physical layout of the data entry area. However, recent inspections of the area have indicated that the changes made during the preimplementation period have not been effectively maintained. Further, and of much greater consequence, at least one of the supervisors no longer distributes and picks up CMC work or schedules equal time on the CMC for the operators on her shift. This latter situation has resulted in some hostility on the part of the operators having less time on the CMC due to the fact that they, by default, must do the bulk of the less desirable work (i.e., IBM) on that shift. Although the incentive program has been implicated in this problem, the same situation not only would exist without the program but did, in fact, exist prior to its implementation. When a supervisor abdicates responsibility for equal workload distribution, the task becomes meaningless in a production and control sense--whether or not an incentive program is involved.

Incidentally, for the LBNS program, the operator assigned to do the IBM work actually has an advantage because the bonus payment for this less desirable work is based primarily upon the time spent rather than the rate. The rate assumed for the IBM work is a straightforward extension of the operators' CMC rate, which, on the average, is about 2500-4000 KS/HR faster than comparable IBM work. Thus, an operator can capitalize by performing a short time at a high rate on the CMC machines and then spending most of the rest of the week doing the slower paced IBM work. In essence, this allows an operator to take advantage of a weakness in the system. Although this is not a serious problem from a management standpoint as long as the total IBM volume is low (less than 20%) and it is equally distributed across all operators, it would be to the organization's advantage to develop IBM performance standards, or other measurement methods, to ensure against such abuses of the incentive program.

Effects on Motivation and Morale

As was mentioned earlier, incentive programs should be designed to consider the needs and desires of persons in the work force, which, at LBNS, turned out to be primarily the opportunity for advancement or promotion. From a morale standpoint, it may reasonably be concluded that this factor would probably have the greatest positive effect. It was also argued, however, that from a work motivation standpoint, a promotion would probably be considerably inferior to the existing program.

Since there has been no change in measures of job satisfaction and morale since the implementation of the program, it appears that these factors have been overshadowed by the lack of opportunity for advancement in the data entry job. However, some of the earlier complaints concerning excessive overtime requirements, as well as lack of recognition, rewards for high productivity, and compensation for having to do difficult procedures, have been eliminated by the program. Many of the current complaints reflect a desire to do more work, which was certainly not the case prior to its implementation.

Program-related Personnel Management Problems

During the course of the year, a number of personnel management problems/questions have arisen in connection with the program. A few of these problems are briefly addressed in the following paragraphs to give the reader some familiarity with the kinds of things that could become associated with work incentive programs of this nature. The list is not intended to be exhaustive but, rather, illustrative of our experience with the program as practiced at LBNS.

Program Acceptance

Initial acceptance of the program might be characterized as "guarded enthusiasm," since the rapid decline in work backlog made some operators feel uneasy about their job security. However, when that security was reinforced and the first bonus checks were awarded (April), there was a rapid increase in performance and enthusiasm. By the time the program had completed the test phase (1 July), only one operator expressed negative feelings concerning its continuance--the complaint being that, since the operators on her shift were hesitant to do IBM card punch work, she, as a slower operator, was "stuck with it." The responsibility for this situation, as was indicated earlier, rests with the shift supervisor; unfortunately, it has not changed significantly in the 6 months since that time.

Shortly after the test phase, a series of related incidents focused further on the distribution of work. It was alleged that an acting supervisor provided easier work to one of the employees, which was viewed as an act of favoritism with racial overtones. Following this, some operators on the shift began to take their own work and to hoard it to capitalize upon bonus opportunities. The "hoarding" and "racial" problems engendered enough hostility among the workers on the shift to necessitate a management intervention. In the ensuing discussion, several of the operators concluded that

the situation had been sparked and aggravated by the competition for work; thus, for the sake of harmony, they felt that the program should be discontinued. At that point, the senior author was called in for consultation. After interviewing six of the seven operators directly involved, it was found that:

1. The only operators who really wanted to discontinue the program were those who were not benefiting from it or were directly involved in the racial issue.

2. Three of the six operators wanted to learn how they could further their skills in order to increase the bonus earned.

3. All of the operators agreed that the problems with competitiveness and hoarding would not have occurred if the work had been distributed fairly.

Finally, one operator, who appeared to be somewhat neutral on the racial issue, indicated that a problem would have developed with or without the incentive program because the favoritism involved the kind of work that people liked to do for reasons other than the bonus. The views expressed by this operator are supported by two other observations. First, our initial interviews with the operators revealed that they had been concerned about the distribution of "easy" work for at least 18 months prior to program implementation; in fact, such concern is probably endemic to the job. Second, since the work standards developed for the program are lower for the more difficult and time-consuming jobs, receiving this kind of work is compensated for by a lessened work requirement. Finally, to settle the problem, the senior author conducted a preliminary examination of OARS II to determine whether work had been unfairly distributed; no evidence of a conclusive nature was found for those involved.

In late September, the senior author conducted a short workshop with the shift supervisors, their assistants, and the IMC to discuss such topics as work distribution and timekeeping methods used by the supervisors, and how efficient work methods could affect the performance (and thus bonus) of the operators. The supervisors indicated at that time that the incentive program was generally accepted. Also, results of a "straw poll" conducted by the author among the operators (N = 23) showed that only two felt the program should be discontinued, and four were indifferent. The remaining 17 favored its continuance.

It appears safe to conclude that the program has been accepted. There has been no indication that a lack of acceptance has had any effect upon performance (even at the individual level), or that any problem that appeared to be associated with a lack of acceptance could not be resolved without adjusting the incentive program.

Work Volume and Productivity

When the program was conceived, there were 27 full-time operators and three working supervisors. At that time, overtime was a fact of life,

sometimes exceeding 70 hours per week. At present, there are 21 operators, and those in the day and graveyard shifts have considerable idle time. Day shift operators have complained about lack of work--stemming, to a great extent, from their feelings that they would be evaluated negatively by management because of idle work periods. This unhealthy situation will continue until the work volume increases to capacity or normal attrition further reduces the work force. Thus, to avoid such a situation, organizations that are considering implementing productivity programs should conduct a thorough review of their hiring and retraining practices and modify them if necessary. For example, crosstraining programs and/or career ladders could be developed prior to full program implementation, and used in place of money as an incentive--if they are carefully designed such that employees clearly understand the requirements and receive regular feedback on their progress. In fact, this kind of program was originally proposed for LBNS (Shumate et al., 1978).

Absenteeism and Quality Control

The program has been criticized by some managers because it appears to have had little or no effect on absenteeism. This factor was, in fact, a concern when the question of the amount of the sharing percentage was being discussed. The issue reduces itself to the following question: Will the possibility of earning a few extra dollars provide enough incentive to bring a person to work on a particular day as well as to induce her to work at a high rate? It was concluded at that time that a bonus large enough to induce a person to come to work would be considerably higher than would be permitted under Federal guidelines. Further, management felt that a person should not be "paid a bonus just for coming to work." However, when the program was introduced, it was strongly emphasized that the opportunity for bonus occurred only when people were, in fact, at work.

The absenteeism problem is certainly one that can be addressed by using rewards, which has been done successfully a number of times in the private sector. From a practical point of view, however, the problem at LBNS is somewhat muted since the existing work force is already too great for the current workload. Although it has been suggested that absenteeism should be punished by reducing the amount of the bonus, this action would be more likely to result in lowered morale and lowered performance--since a reduced bonus would probably not be considered worth the effort required. Informal interviews with the operators suggest that the amount of the sharing percentage is about as low as it can be if it is to have incentive properties.

It is possible that absenteeism has not decreased because of the low volume of work; that is, absentee operators may feel that there is no need for them to be there when there is not enough work to keep all of the operators busy. This possibility is supported by the fact that some of the more conscientious operators explained that they had a low absenteeism rate (during past years) because they knew that there was a lot of work to do and that it was not fair to the other operators.

A second problem related to the program has to do with quality control; that is, error rate. Early in the design stage, it was observed that

corrections made during the verification process represented less than one-half of one percent of the total number of strokes. The Director of MIS felt that this error rate was sufficiently low to negate the necessity of incorporating a bonus "correction" factor in the program. Also, he indicated that the OARS II program was not capable of distinguishing between errors that were considered "very important" and those considered insignificant. Thus, it was decided to admonish the operators concerning error rate when the program was introduced and to monitor the error rate to observe any possible change.

While the error rate has not increased, management has shown some concern that the lack of quality control in the incentive management program may be a weakness. However, the primary impetus for this concern arose in connection with the work of a single operator, who was not doing some of her work in accordance with the instructions in the procedures manual. As a consequence, the person verifying her work had to make a large number of corrections. Members of management suggested that this situation should be handled by penalizing the writing operator by reducing her bonus in amounts corresponding to the number of corrections registered by the verifying operator. Apparently, they believed that the operator assumed she could increase her bonus potential by increasing the amount of time expended; therefore, she was "cheating" on the system and should be punished for it. However, there is no evidence to indicate that the writer was, in fact, benefiting from her actions, since her keystroke rate, which is the basis of the bonus, did not increase. Unfortunately, there is reason to believe that the verifier was slowed to the point that it retarded her performance and denied her the possibility of bonus.

Since this problem really involves only one person, it appears that it might be handled more suitably through some sort of training or personnel action rather than through a bonus-reducing penalty. In addition, introducing the possibility of a penalty for high productivity would most certainly result in a conflict situation for the individual operator, which would undoubtedly have both morale and performance-reducing consequences.

CONCLUSIONS

The Navy Personnel Research and Development Center research team has examined the productivity records of the key entry section for a period exceeding 2 years. Although a conclusive statement may be premature, it appears that productive output (in terms of individual keystroke rate) has leveled off at approximately 11,000 keystrokes per hour. This rate is comparable to production rates of other organizations, public and private, that are regarded as highly efficient. Also, the 25 percent increase in productivity during the past year has had a significant positive effect, as indicated by decreases in time required and levels of work backlog. It must be concluded from this that the experience of the first year with incentive management has been highly successful in the area of productivity and production control.

An unanticipated by-product of the increases in productivity is the relative scarcity of day-to-day work available, which has manifested itself on (1) the distribution of work within and among the shifts, and (2) supervisory practices related to workload and incentive management requirements.

Regarding workload distribution, it is apparent that the day-shift operators are severely underutilized. Although these operators are, on the whole, the most capable, the workload distribution is such that they receive only a small proportion of the regular CMC workload and most of the "unfavorable" (i.e., unmeasured IBM card punch work) jobs. In addition, there is a shortage of daily work for a large portion of the graveyard shift.

Work distribution within shifts appears to be good from a supervisory standpoint, except for the day shift where the supervisor's responsibilities are being greatly neglected. This results in production inefficiencies, as reflected in the distribution of work function, the manner in which the time accounting log is kept, and the manner in which the CMC/IBM balance is maintained for the operators. To resolve this problem, it appears that a reaffirmation and clarification of supervisory responsibilities should be made to the supervisor of this shift.

The most serious problem in production, and one that has implications for the incentive management program, concerns the volume and control of the IBM card punch work. As has been indicated earlier, the volume of this work appears to be on the upswing. However, this increase may be more apparent than real because this work is unmeasured; the volume is determined by the time required, as reflected in records maintained by the shift supervisor, which could be in error.

The implication for the incentive management program is that IBM work, being unmeasured, is rewarded according to the time spent on it--regardless of the actual rate of performance. The rate assumed for the work, as it will be recalled, is a straightforward extrapolation of the operator's corresponding CMC rate. Thus, the IBM performance rate is probably inflated, since the CMC system is much faster than the electromechanical card punch devices. Further, any positive bias in record keeping on the part of the supervisor (either in IBM time or the manner in which CMC time is kept) can spuriously increase the bonus.

RECOMMENDATIONS

The following recommendations are made:

1. The incentive management program should be continued because of the obvious benefits associated with productivity.
2. Because of the shortage of day-to-day work for the data processors on day and graveyard shifts, either the workload or the shift pattern should be reorganized.
3. Steps should be taken to bring the card punch work under control so that it can be meaningfully incorporated into the incentive management program. From both a cost effectiveness and a management standpoint, the best approach would be to program the card punch work for the key entry devices.
4. Supervisors should be more fully integrated into the incentive management program during the coming year. Problems that exist at this level may be alleviated by using a PCRS based upon their job requirements.

REFERENCES

- Bretton, G., Dockstader, S., Nebeker, D., & Shumate, E. A performance contingent reward system that uses economic incentives: A preliminary cost-effectiveness analysis (NPRDC Tech. Rep. 78-13). San Diego: Navy Personnel Research and Development Center, February 1978.
- Hackman, J. R. Is job enrichment just a fad? Harvard Business Review, 1975, 53, 129-138.
- Hamner, W., & Hamner, E. Behavior modification on the bottom line. Organizational Dynamics, 1976, 4, 3-31.
- Nebeker, D., Dockstader, S., & Shumate, E. Predictions of key entry performance using the reconceptualized expectancy model (NPRDC Tech. Rep. 78-11). San Diego: Navy Personnel Research and Development Center, February 1978.
- Nebeker, D., & Moy M. Work performance: A new approach to expectancy theory predictions (NPRDC Tech. Rep. 76TQ-47). San Diego: Navy Personnel Research and Development Center, September 1976. (AD-A030 451)
- Sherry, K. Incentive pay: An experiment that failed. Bank Systems and Equipment, September 1974, 61-68.
- Shumate E., Dockstader, S., & Nebeker, D. Effects of a performance contingent reward system on worker productivity: A field study (NPRDC Tech. Rep., in preparation). San Diego: Navy Personnel Research and Development Center, 1978.
- Vroom, V. Work and motivation. New York: John Wiley & Sons, 1964.

APPENDIX

ROLE OF THE INCENTIVE MANAGEMENT COORDINATOR

THE ROLE OF THE INCENTIVE MANAGEMENT COORDINATOR

With the installation of the incentive management program in the key-punch section of the Management Information Systems Department, it is necessary to have one person responsible for the maintenance and continued development of the program.

A large measure of the success of this program will depend upon this coordinator. The following is a brief outline of the responsibilities of the Incentive Management Coordinator (IMC) that may help serve as a guide to activities and areas of possible action. While the list covers most of the necessary activities of the coordinator, it may not cover all of the responsibilities that are necessary to make the program successful; therefore, initiative on the part of the coordinator will be valuable. In addition, some of the duties listed will not be the direct responsibility of the IMC but, rather, may be carried out by others. The nature of the line of authority to these other individuals will need to be worked out by management and those involved.

1. Responsibilities toward performance capabilities.
 - a. Ensure efficiency of equipment, work flow, and development of CMC procedures.
 - b. Ensure that shift supervisors understand and accept incentive management system.
 - c. Ensure that source documents are well designed and carefully prepared.
 - d. Determine training needs.
 - e. Develop standards for operator selection.
2. Responsibilities toward performance motivation.
 - a. Know and understand incentive program and be able to train the supervisors and operators in its use.
 - b. Develop ways to enlarge the types of incentives offered (e.g., shift incentives, nonmonetary rewards, etc.).
 - c. Provide for awards to be given to those who contribute to keypunch in ways that are not part of incentive plan.
 - d. Ensure that incentive awards are awarded in a timely manner.
 - e. Provide a means to reward shift supervisors for their contributions to the performance of their subordinates.
 - f. Answer questions about the incentive management program.
3. Responsibilities toward performance measurement and reporting.
 - a. Ensure OARS II report is produced on schedule and is functioning properly.
 - b. Monitor the accuracy of standards and develop standards for new CMC procedures.
 - c. Collect and monitor management information that will help evaluate the program (e.g., shift and shop production, labor costs, and leave rates (annual, sick, and LWOP)).

4. Miscellaneous responsibilities.

- a. Inform upper management of program progress.
- b. Inform union of actions taken that concern them.
- c. Monitor effectiveness of the incentive program and identify problem areas needing attention.

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